

Appendix B

SNF Train

Escort Car Capabilities Summary

This document is intended to highlight technical items that may have an impact on the development of specifications and designs for railcars to escort shipments of HLRM. It will also serve as a platform for discussions with prospective vendors in advance of an actual solicitation. The feedback obtained will be used, along with this document, to develop a separate Escort Car technical specification and Request for Proposals.

Table of Contents

1. System Description.....	3
1.1 Operational Description	3
1.2 Consist Configuration	3
2. General Requirements, Escort Car.....	3
2.1 Basic Car Configuration.....	3
2.2 Nominal Data, Car Dimensions, Clearances	3
2.3 Scope of Work	4
2.4 Applicable Regulations and Standards.....	4
3. Carbody	5
3.1 Carbody Structure	5
3.2 Carbody Hardened Areas	5
3.3 Carbody Twist Equalization	5
3.4 Crash-Worthiness.....	5
3.5 Clearances	5
3.6 Securement of Interior Equipment.....	5
3.7 Special Weld Analysis Requirements.....	6
3.8 Coupler & Draft Gear.....	6
3.9 Carbody Exterior Lighting	6
4. Trucks	6
4.1 Structural analysis of unproven trucks.....	6
4.2 Truck Twist Equalization.....	6
4.3 Truck Warp Restraint.....	6
4.4 Dynamic Analysis	6
5. Air System & Brake Equipment	6
5.1 Air Brake System.....	6
5.2 Truck Mounted Air Brake Equipment.....	6
6. Interior Lighting	7
6.1 Functional Lighting	7
6.2 Emergency lighting	7
7. Electrical Power Equipment.....	7
7.1 Generator sets,.....	7
7.2 Low Voltage Power Supply & Battery Charger	7
7.3 Batteries & Enclosure	7
7.4 Circuit Breakers and Low Voltage Distribution	7
8. Communication Equipment.....	7
8.1 Trainlines	7
8.2 Communication Functions	7
8.3 Truck health monitoring storage	7
9. Water Supply and Waste Disposal Systems	7
9.1 Potable water supply system.....	7
9.2 Waste Disposal System.....	8
10. HVAC Heating Ventilating and Air Conditioning System.....	8

Appendix B

SNF Train

Escort Car Capabilities Summary

10.1	HVAC Units	8
10.2	Cooling load requirements	8
10.3	Overhead and Floor Heat Interior Arrangement	8
11.	Interior Arrangement	8
11.1	Basic Interior Arrangement	8
12.	System Safety Monitoring	8
13.	Analyses and Testing	9
14.	Proposal for Production Design and Manufacture	9
14.1	Proposal for Production Car Design	9
14.2	Proposal for Production Car Manufacture.....	9

1. System Description

1.1 Operational Description

- The described railcars will be used in dedicated unit trains carrying casks containing
- High Level Radioactive Material (HLRM), which includes Spent Nuclear Fuel (SNF) and High Level Waste (HLW).
- The requirements of AAR Standard S-2043, "Performance Specification for Trains used to carry High-Level Radioactive Material", must be met for all load conditions.
- It is anticipated that the Escort Cars will be similar in dimensions to passenger cars that meet Plate C clearances.
- SNF trains may travel anywhere within the continental United States
 - Air comfort systems must be designed for the full range of environmental conditions.
 - Freeze protection must be provided for all piping subject to freezing.
- SNF train operations will not be limited to just Class I Railroads. They will travel on branch lines. Routes are not yet determined.
- Trips will take approximately 14 days, round trip from the geologic repository to the HLRM origin and back to Yucca Mountain.
 - Potable water and water and waste water systems should be sized for the anticipated crew and length of single trip.
- Design for a crew of 6, with three crew bedrooms, two bunks in each bedroom.

1.2 Consist Configuration

- Consists will include cask cars, buffer cars, and escort cars.
- Cask cars may number 1 to 3 per train. (depressed center flat cars).
- Buffer cars may number 2 to 4 per train. (flat cars or depressed center flat cars).
- Escort cars may number 1 per train. (single or bi-level passenger car)

2. General Requirements, Escort Car

2.1 Basic Car Configuration

- Single level or bi-level designs will be considered but must remain within plate C clearances.
- The cars will utilize passenger type trucks, unless advanced freight type or other type trucks can be shown to provide adequate ride quality.
- The cars will incorporate HVAC, potable water, waste-water, lighting, and electrical distribution systems for the required loads.
- The interior layout will incorporate areas for sleeping, kitchen and dining, work, and communications.
- Compression end load of 1,000,000 lbs., in accordance with AAR Standard S-2043, and other structural requirements of 49 CFR Part 238, subpart C.

2.2 Nominal Data, Car Dimensions, Clearances

Maximum nominal speed	70 mph
Weight equalization between trucks	TBD
Lateral imbalance not to exceed	TBD
Weight fully loaded ready to run	TBD
AAR Clearance plate	Plate C

Minimum curve radius	12 degree (478.3 ft radius)
Minimum curve radius coupled units	12 degree (478.3 ft radius)
Minimum curve radius coupled to a 50-foot flatcar	12 degree (478.3 ft radius)
Clearance above TOR, fully worn wheels, defective springs.	2 ¾" worst case
Carbody Width over grab rails	10'-6" (maximum)
Length Over Coupler Pulling Faces	TBD (85' estimated)
Truck Centers	TBD (59'-6" estimated)
Truck Wheel Base	TBD (8'-6" estimated)
AAR Coupler Height	34.5"
Height, top of rail to top of roof line, new wheels	14' 6" (maximum)

2.3 Scope of Work

Prototype carbuilders scope of work includes:

- Prototype Design
- Analysis & Reports (per AAR Standard S-2043)
- Prototype Manufacture
- Prototype Testing & Reports (per AAR Standard S-2043)
- AAR Certification Process (per AAR Standard S-2043)
- DOE Acceptance
- Preparation of a proposal to design and manufacture production vehicles

See Appendix C for further details.

2.4 Applicable Regulations and Standards

Meet all applicable AAR standards and recommended practices:

- Meet AAR Standard S-2043 for trains used to carry high-level radioactive material
- Meet all applicable AAR Standards within and including MSRP M-1001.
- Office Manual of the AAR Interchange Rules
- Field Manual of the AAR Interchange Rules

Meet all applicable Federal Regulations:

- 49 CFR 172 Hazardous Materials Table, Special Provisions, ...
- 49 CFR 174 Carriage by Rail (Hazardous Materials)
- 49 CFR 210 Railroad Noise Emission Compliance and Regulations
- 49 CFR 215 Railroad Freight Car Safety Standards
- 49 CFR 221 Rear End Marking Device – passenger, commuter, and freight trains
- 49 CFR 231 Railroad Safety Appliance Standards
- 49 CFR 232 Brake System Safety Standards for Freight and other non-Passenger Carrying Trains and equipment; End-of-Train Devices

Meet all applicable EPA Requirements

- 40 CFR 201, Noise Emission Standards For Transportation Equipment; Interstate Rail Carriers

Meet all NTSB recommendations regarding tie-down of equipment in passenger cars, and Securement of luggage.

The above-listed regulations are not all-inclusive. Additional regulations along with the regulations mentioned above will be listed in the DOE Request for Proposal.

3. Carbody

The carbody structure will be designed in compliance with AAR Standard S-2043, AAR MSRP, and referenced standards and regulations, as well as all applicable regulations. The following items highlight a few aspects:

3.1 Carbody Structure

Carbody structure will adhere to the following requirements:

- Dead load case per standard AAR MSRP M-1001,
- Live load case per actual load conditions,
- Jacking load per MSRP M-1001, paragraph 4.1.6
- Twist load MSRP M-1001, paragraph 11.3.3.5
- Twist load allowable design stress – 56% yield

Additionally, the structure of the escort cars will adhere to the requirements of 49 CFR Part 238, Subpart C, “End-of-car structure”, which includes requirements for: static end strength (except replacing 800,000 lbs with 1,000,000 lbs.); anticlimbing mechanism; link between coupling mechanism and carbody; collision posts; rollover strength; side structure; and truck to carbody attachment.

The carbody skin on all sides, ends, roof areas, and floor will consist of 3/8 inch-thick hardened alloy steel, except where specifically required otherwise.

3.2 Carbody Hardened Areas

Specific areas of the car, to be specified at a later date.

3.3 Carbody Twist Equalization

- Special requirements for all HLRM train cars (AAR Standard S-2043)
 - Raise 2 inch, one side all trucks one end of car, no load below 60%
 - Raise 3 inch, one side all trucks one end of car, no load below 40%

3.4 Crash-Worthiness

Crash-worthiness requirements for HLRM train freight cars are based upon AAR hazardous materials transport requirements.

- Running gear retention in case of derailment (AAR Standard S-2043)
 - Trucks remain attached to carbody
 - Wheels & axle retained in truck
 - Top and bottom shelf coupler

3.5 Clearances

- Clearances per AAR MSRP S-2028, Plate C.

3.6 Securement of Interior Equipment

- Luggage and installed equipment shall be secured according to the latest recommendations of the NTSB and a 5g deceleration.

3.7 Special Weld Analysis Requirements

Special Weld Analysis Requirements for HLRM Carrying Railcars (American Welding Society (AWS) D15.1, section 23.3 and 23.4, "Railroad Welding Specification"):

- Full penetration butt welds – 100% radiographic or ultrasonic inspection.
- All critical welds identified – require 100% non-destructive inspection.
- Construction drawing – 100% visual inspection and 10% nondestructive inspection for all welds not identified as full-penetration butt welds or critical structure.

3.8 Coupler & Draft Gear

- Top and bottom shelf couplers are required.
- Couplers will adhere to AAR Standard S-2043 and MSRP requirements for top and bottom shelf couplers.

3.9 Carbody Exterior Lighting

- Routine lighting requirements are in accordance with AAR Standards and Federal Regulations.
- Special lighting requirements are not yet defined.

4. Trucks

4.1 Structural analysis of unproven trucks

- Meet AAR truck specifications M-202 – Bolster Test Specification, M-203 – Side Frame Test, Specification, M-203A, M-213 Fabricated Steel Truck Specification.
- Perform an accelerated life (fatigue) test.

4.2 Truck Twist Equalization

Special requirements for all HLRM train cars AAR Standard S-2043:

- With one wheel raised 2 inches, no wheel load shall be below 60%.
- With one wheel raised 3 inches, no wheel load shall be below 40%.

4.3 Truck Warp Restraint

- Not developed yet.

4.4 Dynamic Analysis

- Baseline analysis similar to MSRP M-1001, Chapter XI.
- Perturbed Track (AAR Standard S-2043).
- Perturbed Track Special Cases (AAR Standard S-2043).

5. Air System & Brake Equipment

5.1 Air Brake System

- The Air Brake System and associated equipment shall be designed and manufactured in accordance with AAR Standard S-2043.

5.2 Truck Mounted Air Brake Equipment

- Latching handle vented cut out cock at each brake cylinder

6. Interior Lighting

6.1 Functional Lighting

Appropriate lighting in accordance with OSHA standards will be provided for:

- Work areas
- Food Preparation areas
- Sleeping areas
- General illumination for non-specific areas or hallways.

6.2 Emergency lighting

- Emergency lighting will consist of a percentage of the total lighting, and will include light fixtures located in key places to facilitate the requirements of operation in such conditions.
- Emergency lighting will be supplied by an emergency battery supply in the case of failure of the main power supply generator and the backup generator.

7. Electrical Power Equipment

7.1 Generator sets,

- 2 units will be included, 230 V, 50 kW each anticipated, with fuel storage
- Both units operating together will supply the full power requirement
- One unit will continue operating if the other fails with load shedding capability.

7.2 Low Voltage Power Supply & Battery Charger

7.3 Batteries & Enclosure

7.4 Circuit Breakers and Low Voltage Distribution

8. Communication Equipment

8.1 Trainlines

- Communication trainlines
- ECP brake and truck health monitoring trainlines

8.2 Communication Functions

- Not developed yet.

8.3 Truck health monitoring storage

- Data collection shall be accomplished via portable computer

9. Water Supply and Waste Disposal Systems

9.1 Potable water supply system

Water system complete, to include the following equipment:

- Potable water tank with capacity of 1000 gallons

- Water storage tanks
- Water raising system
- Water valves
- Antifreeze protection
- Water heaters
- Piping and fittings

9.2 Waste Disposal System

Waste disposal system (vacuum type) complete, to include the following:

- Retention tank with capacity of 1000 gallons
- Toilet assembly
- Waste tank assembly
- Controls
- Antifreeze protection
- Water heaters
- Piping and fittings

10. HVAC Heating Ventilating and Air Conditioning System

10.1 HVAC Units

- Two roof mounted HVAC units
- Complete with central controls
- Positive pressure ventilation shall be maintained, even upon HVAC failure.

10.2 Cooling load requirements

- TBD, based upon environmental conditions of all anticipated routes.

10.3 Overhead and Floor Heat Interior Arrangement

- Floor heaters will be used for heat
- Overhead heaters in the HVAC unit may be used for reheat

11. Interior Arrangement

11.1 Basic Interior Arrangement

- 1 General operations area
- 3 Bedrooms
- 2 Toilet Rooms
- 1 Shower Room
- 1 Kitchen Area, including food storage, food preparation, dining / work area
- 1 Lounge Area.

12. System Safety Monitoring

The System Safety Monitoring, which includes sensing, transmitting, and storing truck performance data, shall be designed and manufactured in accordance with AAR Standard S-2043.

13. Analyses and Testing

Analyses and Testing shall be performed in accordance with AAR Standard S-2043, and shall include the following: Single-Car Tests, Multiple-Car Tests, System Monitoring Tests, and Revenue Service Tests. Test activities, reporting, and analyses shall be completed through coordination with other vehicle contractors, the DOE, and the AAR.

14. Proposal for Production Design and Manufacture

14.1 Proposal for Production Car Design

The Contractor shall prepare and submit to DOE a proposal to adapt the prototype Escort Car design for manufacture of a specified number of production vehicles, in accordance with any changes required as a result of the AAR review and test process.

14.2 Proposal for Production Car Manufacture

The Contractor shall prepare and submit to DOE a proposal to manufacture, deliver and support a specified number of production vehicles, including special tools, documentation, warranty, spare parts, and warranty. The proposal shall specify the overall cost for the production vehicle order, the schedule for manufacture and delivery, and the management and quality assurance processes to be applied.